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Bowling et al.

[11] **4,109,226**

[45] **Aug. 22, 1978**

[54] **DISCONNECT SWITCH WITH RESET MECHANISM**

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[73] Assignee: **General Electric Company**, Louisville, Ky.

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[51] **Int. Cl.**[2] **H01H 71/18**

[52] **U.S. Cl.** **337/130**; 337/140

[58] **Field of Search** 335/166; 337/128, 129, 337/130, 139, 140, 382, 393, 395

[56] **References Cited**

U.S. PATENT DOCUMENTS

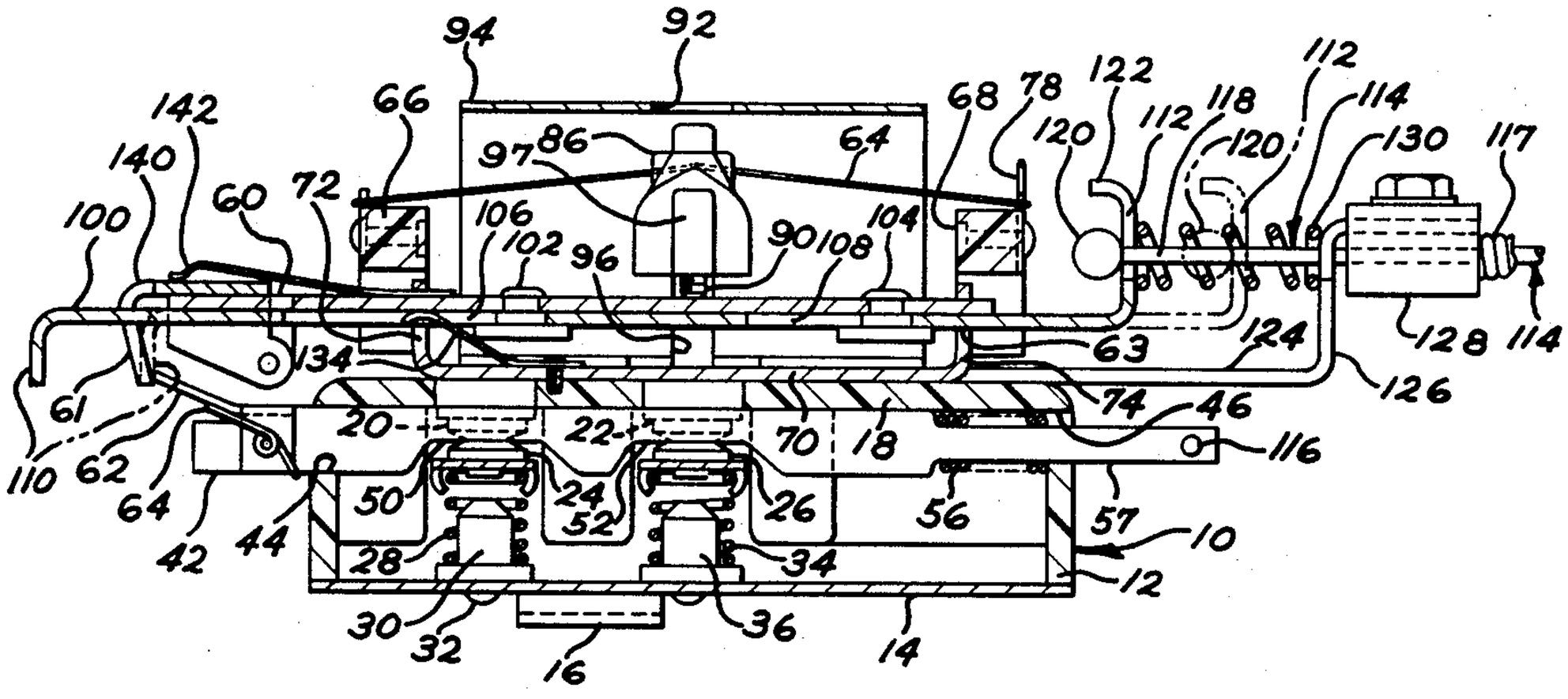
3,142,737	7/1964	Brackett	337/130
3,176,099	3/1965	Bergsma	337/140 X
3,514,733	5/1970	Staples	337/140 X
3,864,649	2/1975	Doyle	335/166 X

Primary Examiner—George Harris
Attorney, Agent, or Firm—Francis H. Boos

[57] **ABSTRACT**

A disconnect switch or hot wire relay for use with a ground fault circuit interrupter in a power circuit to a load, such as an electric range, to provide ground fault protection for any circuit of the range. The switch has normally closed switch contacts, a biased actuator plunger for opening the contacts, a latching member for disabling the plunger, and an adjustable hot wire for releasing the latch and hence the plunger when the circuit is overloaded. The plunger of the switch is manually resettable from a remote position. The reset mechanism has an anti-tease or trip-free feature which prevents the operator from holding the disconnect contacts closed while a fault is present in the circuit.

8 Claims, 4 Drawing Figures



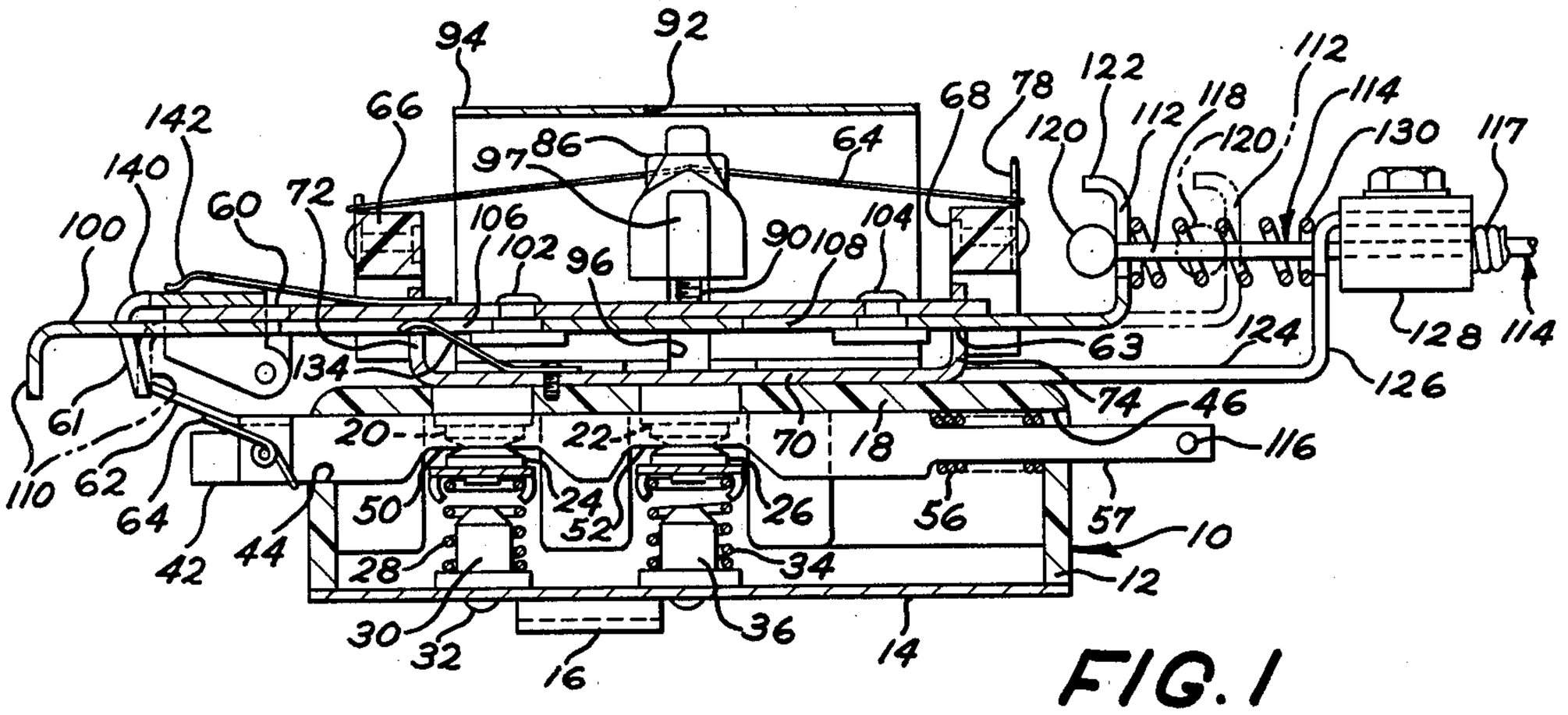


FIG. 1

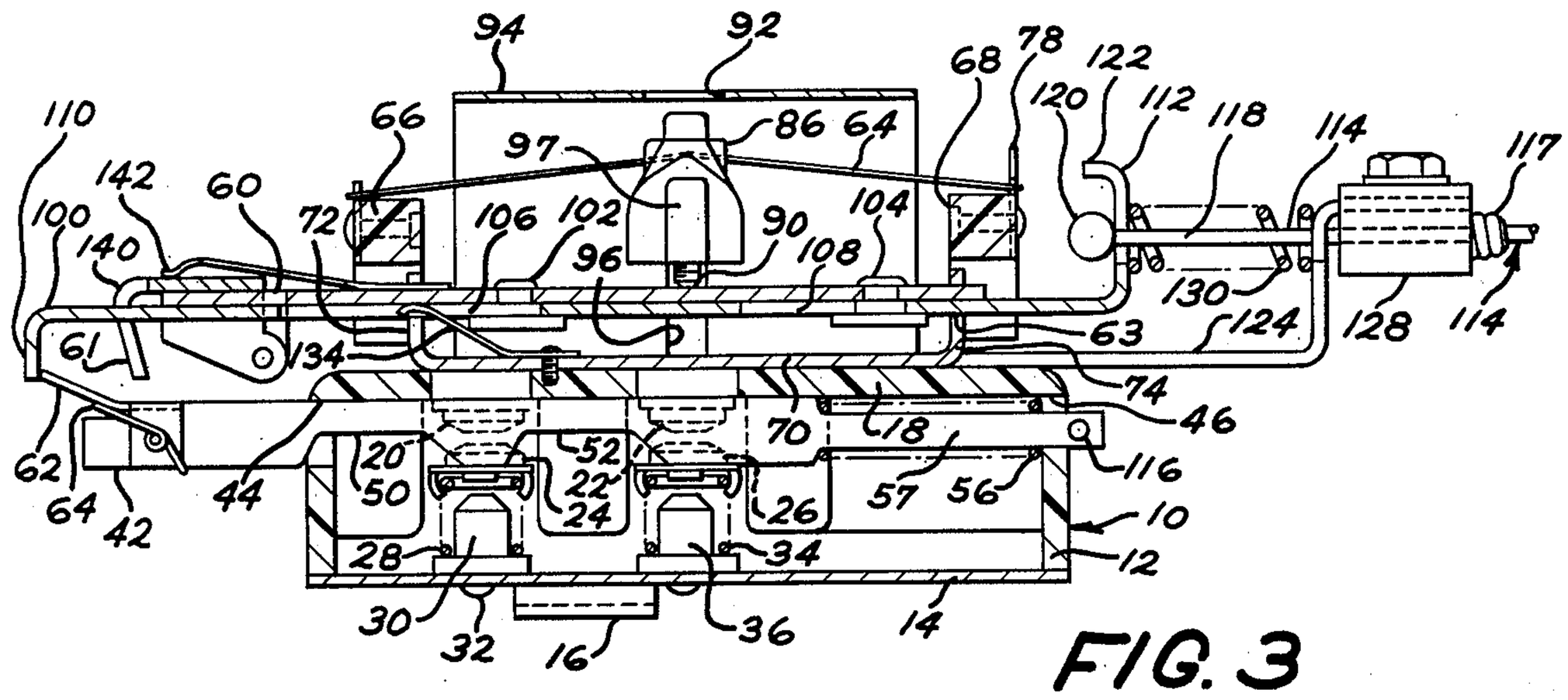


FIG. 3

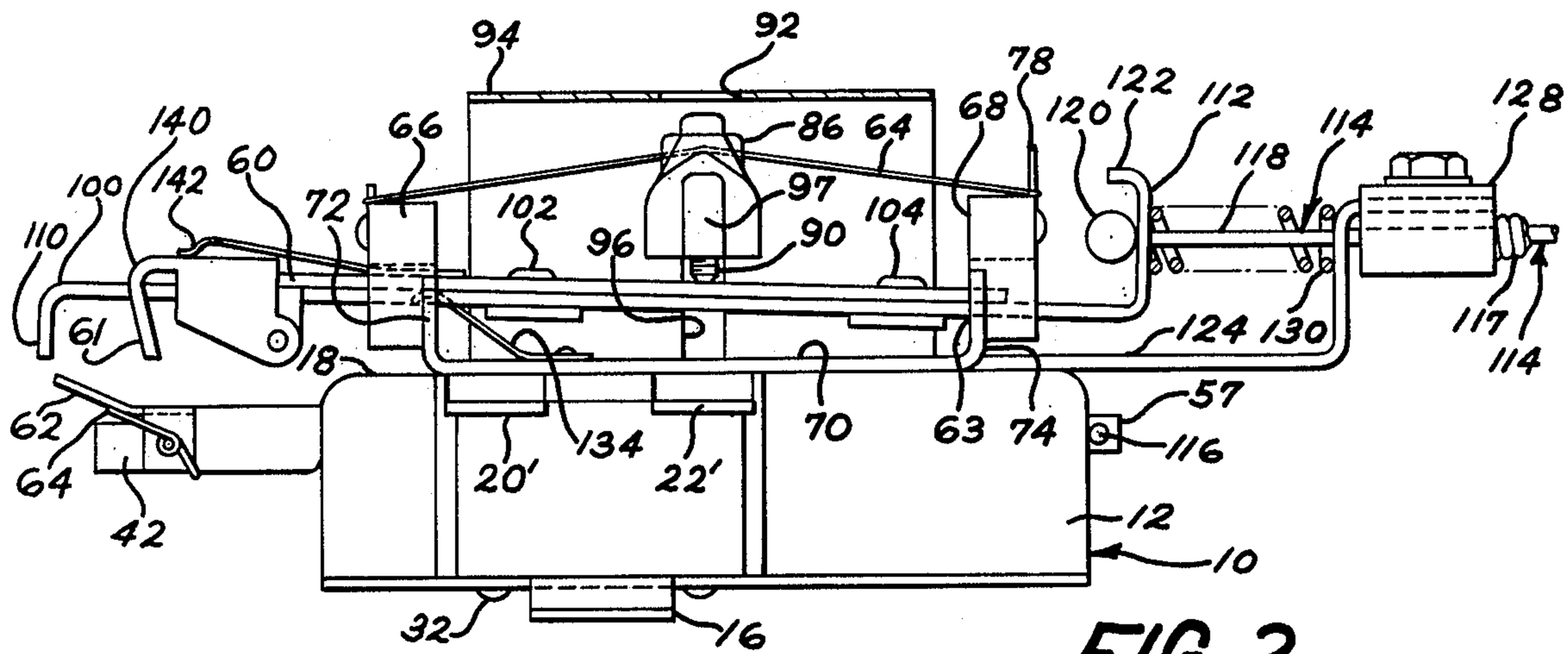


FIG. 2

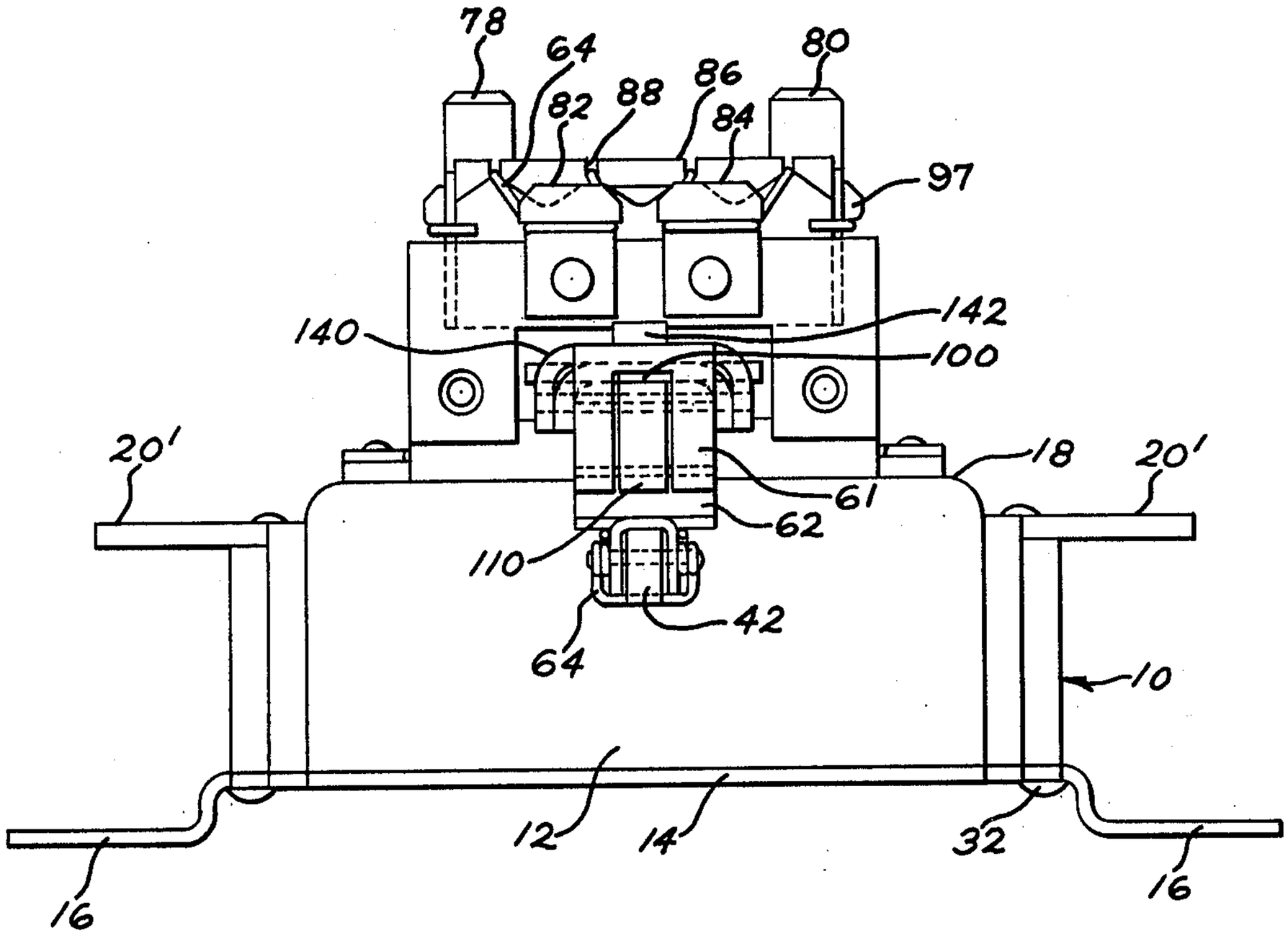

78
64
82
88
86
84
80
97
140
142
100
20'
18
20'
61
62
110
42
64
10
12
14
32
16
16

FIG. 4

DISCONNECT SWITCH WITH RESET MECHANISM

CROSS-REFERENCE TO RELATED APPLICATION

This invention is a later improvement of the time delay disconnect switch of application Ser. No. 710,568 now U.S. Pat. No. 4,054,857 in the name of Teamus Bowling, which was filed on Aug. 2, 1976 and is assigned to the same assignee as the present invention.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to circuit breakers and hot wire relays for use in protecting a circuit from high leakage current or short circuits.

2. Description of the Prior Art

The present invention relates to a time delay disconnect switch or hot wire relay as one component of a ground fault circuit interrupter for use with an appliance such as an electric range to remove power for the purpose of preventing high current leakage hazards or short circuit damage. Such ground fault circuit interrupters (GFCI) are required by the Underwriters Laboratory, Inc., for use in bathrooms, with outdoor residential receptacles, swimming pools and the like.

The present invention is combined with a disconnect switch in the form of a hot wire relay of a special design to obtain time delay, as is described in the above-cited pending application. An example of a simple hot wire relay is shown in the Bergsma Patent No. 3,176,099 which uses an in-circuit self-heating resistance wire referred to as a "hot" wire or "sag" wire such that when the magnitude of the input current exceeds a certain limit the hot wire will elongate sufficiently for making or breaking the output circuit-controlling electrical contact.

Another example of a snap-action hot wire power-switching relay is described in the Staples U.S. Pat. No. 3,514,733, which is assigned to the assignee of the present invention. One of the main differences between the disconnect switch of the present invention and the Staples relay is the construction to provide time delay in the present disconnect switch to avoid spurious operation and distructive arcing and premature failure.

The Doyle U.S. Pat. No. 3,864,649 shows a ground fault circuit interrupter and its disconnect switch combined in a single wiring device, while in the present invention the disconnect switch is separate from the sensing and firing circuit.

The present disconnect switch employs wiping contact action which serves to maintain the contact surfaces clean, but this is not generally new, per se, as is depicted in the Sway U.S. Pat. No. 2,671,840 and the Hottenroth U.S. Pat. No. 2,350,960, both of which are assigned to the present assignee. It is felt that the present invention relates to a manual reset mechanism which can be operated from a remote position. This reset mechanism is such that it prevents the operator from holding the disconnect contacts closed while a fault is present in the circuit.

The principal object of the present invention is to provide a disconnect switch for use in a ground fault circuit interrupter system with a manual reset mechanism which may be operated from a remote position, but which is disabled whenever a fault is present in any

circuit so as to prevent the operator from being able to hold the disconnect contacts closed.

A further object of the present invention is to provide a reset mechanism for a disconnect switch which cooperates with a latching mechanism for an actuator plunger that, when released by the latching mechanism, serves to open the switch contacts.

A further object of the present invention is to provide a reset mechanism of the class described which is carried by the latching mechanism and is movable with respect thereto for being able to cock the actuator plunger after the ground fault has been corrected.

SUMMARY OF THE INVENTION

The present invention, in accordance with one form thereof, relates to a ground fault disconnect switch for controlling the flow of current in a circuit and interrupting the flow in the event of a predetermined high current. The switch uses a thermal-responsive means for controlling a latch means which in turn controls a switch actuator means for opening normally closed switch contacts so that a predetermined current flow in a conductor causes the thermal-responsive means to release the latch means from engagement with the actuator means, thereby forcing the movable contacts open. A manual latch reset mechanism for cocking the actuator means is capable of remote control so that the disconnect switch can be reset from a position remote from the location of the disconnect switch. This reset mechanism is withdrawn from the actuator means when a ground fault is still present in the circuit so that the operator is unable to re-establish the circuit through the switch until the ground fault has been eliminated.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention will be better understood from the following description taken in conjunction with the accompanying drawings and its scope will be pointed out in the appended claims.

FIG. **1** is a cross-sectional elevational view of a disconnect switch of the present invention, showing the switch contacts in the normally closed position. A hot wire is shown in tension at the top of the switch, and it is furnished with an armature that bears down onto a latch member that in turn disables a spring-biased actuator plunger. When the latch member is released, the plunger will cause the movable contacts to open the circuit, as well as to de-energize the hot wire. Added to the latch mechanism is a manual, remote controlled reset mechanism.

FIG. **2** is an instantaneous cross-sectional elevational view of the disconnect switch, similar to that of FIG. **1**, after a ground fault has occurred and the hot wire has released the latch member, causing the actuator plunger to spring from right to left.

FIG. **3** is another cross-sectional elevational view of the disconnect switch showing the condition of the switch after the ground fault has been cleared to render the reset mechanism capable of restoring the actuator plunger to its latched position, as shown in FIG. **1**.

FIG. **4** is a left end view of the disconnect switch of FIG. **1** with the cover plate removed, showing the disconnect switch in its normal closed position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to a consideration of the drawings, and in particular to FIG. **1**, the disconnect switch **10** com-

prises a hollow insulating housing **12** that is open at the bottom and adapted to be closed by a flat metal cover plate **14**, which plate has a pair of oppositely disposed mounting ears **16**, as is best seen in FIG. **4**. A large portion of the basic disconnect switch structure is described and claimed in the abovementioned pending application Ser. No. 710,568 now U.S. Pat. No. 4,054,857. Fixed to the underside of the top wall **18** of the housing **12** are two pairs of fixed contacts **20** and **22** which are each provided with a fixed terminal **20'** and **22'** respectively, which terminals extend outwardly from the side of the housing, as is best seen in FIG. **4**. A movable contact bar **24** cooperates with the first pair of fixed contacts **20**, and movable contact bar **26** cooperates with the second pair of fixed contacts **22**. Each contact bar **24** and **26** is a bridging contact member which is spring-biased upwardly into a normally closed position with the mating fixed contacts, as is seen in FIG. **1**. Contact bar **24** is seated on a central compression spring **28** that is in turn seated on an insulating post **30** that is attached to the cover plate **14** by a fastener **32**. Similarly, the contact bar **26** is provided with a compression spring **34** that is seated on an insulating post **36**.

The disconnect switch housing **12** is provided with an actuator plunger **42** of insulating material which is elongated so that it extends completely through the housing and out suitable openings **44** and **46** in the opposite end walls of the housing. This plunger is supported within these openings so that it is capable of sliding back and forth a limited amount within the housing. The actuator plunger **42** is a beam-like member that has a pair of recesses **50** and **52** in its lower edge so that when these recesses are positioned over the contact bars **24** and **26**, respectively, the plunger is out of contact with the contact bars so that the biasing springs **28** and **34** are free to force the movable contact bars against the pairs of fixed contacts **20** and **22**.

Each recess **50** and **52** is provided with an inclined ramp or cam surface which is adapted to act against the side of the related contact bar **24** and **26**, respectively, for causing the contact bars to tilt or rock on their supporting springs **28** and **34**, as the actuator plunger **42** is shifted back and forth through the housing. Thus, when the actuator plunger **42** is shifted to the left from the position of FIG. **1** to the position of FIG. **3**, the movable contact bars **24** and **26** are forced downward by the inclined ramps until they assume the position shown in FIG. **3**, where they are held separated from the fixed contacts. A biasing spring **56** is fitted over a reduced section **57** of the plunger at the right end thereof in FIG. **1** to bear against the adjacent end wall of the housing **12** to normally exert a pushing force on the plunger toward the left.

Since this disconnect switch **10** is provided with normally closed switch contacts, as is shown in FIG. **1**, some means must be provided for disabling the actuator plunger **42**. This disabling means is in the form of a biased latch member **60**, which extends across the top of the switch housing and has a downturned finger **61** that cooperates with a pivoted pawl **62** that is fastened on the left end of the actuator plunger **42**. The pawl **62** is provided with a torsion spring **64** for biasing the pawl into an upward position, as is shown in FIGS. **1–3**.

This latch member **60** is a thin metal strip that is supported at a fulcrum point **63** adjacent the right side of the switch housing. Cooperating with the latch member **60** is a hot wire **64** of sinuous or looped configuration that is supported between a pair of insulating posts **66** and **68** at opposite ends of the housing. These insulating posts are supported from a metal base plate **70** that is attached to the top wall **18** of the switch housing **12**. This base plate has turned-up end flanges **72** and **74** to which the insulating posts **66** and **68** are fastened, respectively. Thus, the fulcrum point **63** is formed by the turned-up flange **74** supporting the latch member **60**. The insulating post **68** includes two vertical, spaced, terminal blades **78** and **80**, as is best seen in FIG. **4**. Thus, the hot wire **64** is connected at one end to the terminal blade **78** and then extends across the switch housing to a dummy metal terminal **82**, as is seen in FIG. **4**, and then extends back to the opposite side and is wrapped around a second dummy terminal and back again to the dummy terminal **84** and finally it is connected to the second terminal blade **80**, as is well understood in this art.

An insulating armature **86** is interposed between the hot wire **64** and the latch member **60** so that any elongation or contraction of the hot wire **64** is reflected as a variable force bearing against the latch member **60**. Notice in the end view of FIG. **4**, the slotted nature of the top edge of the armature **86** for accommodating the hot wire **64** therethrough. These slots are identified by reference numeral **88**. A calibrating screw **90** is threaded down through the armature **86** for bearing against the latch member **60**. This calibration screw **90** is accessible through an access opening **92** in the a protective plate **94** for adjusting the tension on the hot wire so that the switch contacts will function at the exact control temperature. The position of the insulating armature **86** is stabilized by the cover plate **94** because the opposite walls of the cover plate are provided with vertical slots **96**, as shown in FIG. **2**, which receive side extensions **97** of the armature which slide therein.

The detailed nature of the disconnect switch **10** as described above is generally the same as in the copending patent application Ser. No. 710,568 now U.S. Pat. No. 4,054,857 which was identified above.

The present invention is related to a manual latch reset mechanism for cocking the actuator plunger **42** so as to disable the plunger under normal operating conditions so that the movable contact bars **24** and **26** will close with the fixed contacts **20** and **22**. This reset mechanism includes a biased bar **100** that is carried by the latch member **60** and is slidable with respect thereto. The latch member includes a pair of rivet members **102** and **104** which extend into elongated slots **106** and **108**, respectively, in the reset bar **100** so that these rivets support the reset bar **100** from the latch member **60** while allowing for limited longitudinal sliding movement therebetween. The left end of the reset bar **100** has a downturned hook formation **110** that is capable of engaging the pawl **62** of the actuator plunger **42**, as is seen in FIG. **3**. The opposite end of the reset bar **100** is provided with an upturned flange **112** to which an elongated choke cable **114** is attached. This choke cable **114** has an outer sheath **117** and an inner tension member **118** with a ball formation **120** on the end thereof which engages behind the flange **112** by slipping the tension member **114** down through a vertical slot **122** in the flange. The metal base plate **70** has a side extension **124** with a turned-up mounting flange **126** that is provided with a clamp member **128** for gripping the outer sheath **117** of the choke cable **114**. The opposite end (not shown) of the choke cable **114** would probably be positioned in the control panel of the range in which this control is mounted. A coil spring **130** surrounds the

tension member **118** in the area between the flange **112** of the reset bar **100** and the mounting flange **126**. This choke cable **114** represents a remote controlled, manually operable means for moving the reset bar **100**. This spring **130** biases the reset bar **100** to the left as is shown in FIGS. **1–3**, but the bar **100** may be shifted to the right by pulling on the tension member **118**, as is clear from the dotted line position of the flange **112** shown in FIG. **1**.

Now comparing FIGS. **1** and **2**, when a ground fault occurs in the circuit, the hot wire **64** will be energized instantaneously, causing it to heat up and become elongated which relaxes the downward pressure of the calibration screw **90** on the latch member **60**. A leaf spring **134** is supported from the base plate **70**, and it bears up against the underside of the reset bar **100** to urge the bar **100** and its supporting latch member **60** in an upward direction. Thus, when the hot wire **64** is elongated, the leaf spring **134** causes the combined latch member **60** and reset bar **100** to pivot about the fulcrum point **63** until the finger member **61** of the latch member **60** becomes disengaged from the pawl **62**, thereby releasing the actuator plunger **42** so that its compression spring **56** may expand and shift the plunger to its left, extreme position of FIG. **2**. A stop pin **116** is provided in the right end of the actuator plunger **42** to limit its free movement toward the left as the stop pin comes to bear against the end wall of the switch housing **12**, as seen in both FIGS. **2** and **3**.

When a circuit fault has been cleared, the combined latch member **60** and reset bar **100** will move down from the position of FIG. **2** to the position of FIG. **3**, because the hot wire **64** will be de-energized and hence will tighten up causing the armature **86** to press down on the latch member **60** of FIG. **2** causing it to move to the position shown in FIG. **3**. Thus, if the choke cable **114** were to be actuated, the hook **110** of the reset bar **100** would engage the pawl **62** of the actuator plunger **42** and the plunger would be cocked when the pawl **62** slips behind the finger of the latch member **60**. Notice the latch finger **61** is part of a hinge formation **140** so that when the actuator plunger **42** is being cocked the pawl **62** will engage the finger **61** and pivot it upwardly so that the finger does not prevent the plunger from being cocked. A leaf spring **142** is fastened to the top of the latch member **60** and it bears down on the top of the hinge formation **140** so as to urge the finger **61** downward. This spring **142** permits the finger **61** to override the pawl **62** when the plunger **42** is being returned to its cocked or ON position.

Looking at the end view of FIG. **4**, it will be noticed that the finger **61** of the latch member **60** is bifurcated to straddle the narrowed end of the reset bar **100** adjacent the hook **110**. Thus, the hook **110** may move from its full-line position of FIG. **1** to its dotted-line position without interference from the finger **61** of the latch member **60**.

Modifications of this invention will occur to those skilled in this art. Therefore, it is to be understood that this invention is not limited to the particular embodiments disclosed but it is intended to cover all modifications which are within the true spirit and scope of this invention as claimed.

What is claimed is:

1. A ground fault disconnect switch for controlling the flow of current in a circuit and interrupting the flow in the event of a predetermined high current, said switch comprising a housing with fixed and movable electric contact means for making and breaking the circuit, biasing means for holding the movable contact means in engagement with the fixed contact means, biased actuator means for forcing the movable contact means away from the fixed contact means, and latch means for disabling the actuator means, an adjustable thermal-responsive means acting upon the said latch means for holding the latch means in engagement with the said actuator means, whereby a predetermined current flow in the circuit causes the thermal-responsive means to release the latch means from engagement with the actuator means so the actuator means is free to open the switch contacts; the invention comprising a manual latch reset mechanism for cocking the actuator means so the actuator means is disabled, said reset mechanism including a remote controlled biased bar that is carried by the latch means and is movable with respect thereto.

2. The invention of claim **1** wherein the said biased bar is capable of limited longitudinal sliding action with respect to the latch means, one end of the bar having a hook means for engaging the adjacent end of the actuator means, the opposite end of the bar including an elongated tension means and biasing means for urging the bar in a direction toward the hook end of the bar.

3. The invention of claim **2** wherein the end of the latch means that is adjacent the hook end of the bar has a finger for engaging the adjacent end of the actuator means, while the adjacent end of the actuator means has a pawl that is adapted to be engaged by either the hook end of the bar or the finger of the latch means, said pawl being slidable under the finger when the bar is cocking the actuator means.

4. The invention of claim **3** wherein the switch housing includes a support surface for the latch means at the end opposite the latch finger whereby when the thermal-responsive means releases the latch means, the latch means pivots about this support surface and the finger disengages itself from the pawl of the actuator means.

5. The invention of claim **4** wherein spring means on the switch housing remote from the said support surface maintains contact of the latch means with respect to the thermal-responsive means.

6. The invention of claim **5** wherein the said latch finger is a bifurcated spring-biased pivotal member that straddles the hook end of the reset bar.

7. The invention of claim **1** wherein there is a lost motion pin and slot connection means holding the reset bar on the latch means.

8. The invention of claim **1** wherein the said actuator means is a spring-biased plunger that extends through the housing and has a pawl adjacent one end thereof, and said latch means is an elongated beam external of the housing which generally overlies the plunger and has a bifurcated spring-biased pivotal member on its end for cooperation with the pawl of the actuator plunger, and which straddles the reset bar, the adjacent end of the reset bar having a hook also for engaging the pawl of the actuator plunger.

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